

## **CLAIMS:**

1. An improved machine vision vehicle wheel alignment system including a first camera system configured to view one or more optical targets disposed on a first side of a vehicle, a second camera system configured to view one or more optical targets disposed on a second side of the vehicle, and a data processor configured to process images and calculate vehicle wheel alignment measurements, the improvement comprising:

wherein said first camera system and said second camera system are configured for independent movement relative to each other; and

wherein said data processor is configured to establish a common reference coordinate system between said first camera system and said second camera system utilizing images obtained by said first and second camera systems.

2. The improved machine vision vehicle wheel alignment system of Claim 1 further including at least one reference target structure, said at least one reference target structure disposed within a field of view of said first camera system and within a field of view of said second camera system; and

wherein said data processor is configured to utilize identified relationships between said at least one reference target structure, said first camera system, and said second camera system to establish said common reference coordinate system.

3. The improved machine vision vehicle wheel alignment system of Claim 2 wherein said at least one reference target structure includes a first target component disposed within a field of view of said first camera system, a second target component

disposed within a field of view of said second camera system, said first and second target components disposed in a predetermined relationship.

4. The improved machine vision vehicle wheel alignment system of Claim 1 further including

a first reference target disposed within a field of view of said first camera system, said first reference target secured in a predetermined relationship to said second camera system; and

a second reference target disposed within a field of view of said second camera system, said second reference target secured in a predetermined relationship to said first camera system; and

wherein said data processor is configured to utilize identified relationships between said first and second reference targets and said first and second camera systems to establish said common reference coordinate system.

5. The improved machine vision vehicle wheel alignment system of Claim 1 further including:

a first reference target disposed adjacent a fixed mounting structure associated with said first camera system;

a second reference target disposed adjacent a fixed mounting structure associated with said second camera system;

said first associated fixed mounting structure and said second associated fixed mounting structures disposed in a predetermined relationship;

wherein said first camera system is configured to view said second reference target;

wherein said second camera system is configured to view said first reference target; and

wherein said data processor is configured to establish a common reference coordinate system between the first and second camera systems utilizing images of said first and second reference targets and said predetermined relationship of said associated mounting structures.

6. The improved machine vision vehicle wheel alignment system of Claim 5 wherein said first camera system is configured to be moved relative to said associated fixed mounting structure; and

wherein said second camera system is configured to be moved relative to said associated fixed mounting structure.

7. The improved machine vision vehicle wheel alignment system of Claim 1 further including at least one additional camera system, said at least one additional camera system configured for independent placement relative to said first and second camera systems; and

wherein said data processor is configured to establish said common reference coordinate system between said first camera system, said second camera system, and said at least one additional camera system.

8. The improved machine vision vehicle wheel alignment system of Claim 7 further including a plurality of reference target structures, each of said plurality of reference target structures disposed within a field of view of at least two camera systems; and

wherein said data processor is configured to utilize identified relationships between said plurality of reference target structures and each of said camera systems to establish said common reference coordinate system.

9. The improved machine vision vehicle wheel alignment system of Claim 1 further including a plurality of reference targets, each of said plurality of reference targets disposed within a field of view of two of said camera systems; and

wherein said data processor is configured to utilize identified relationships between at least one of said plurality of reference targets and each of said camera systems to establish said common reference coordinate system.

10. An improved machine vision vehicle wheel alignment system including a first set of cameras configured to view one or more optical targets disposed on the first side of a vehicle, a second set of cameras configured to view one or more optical targets disposed on the opposite side of the vehicle, and a data processor configured to process images and calculate vehicle wheel alignment measurements, the improvement comprising:

a vehicle runway system, said vehicle runway system having first and second runways;

a first reference target within the field of view of at least one camera in said first set of cameras;

a second reference target within the field of view of at least one camera in said second set of cameras;

wherein said first and second reference targets have a predetermined positional relationship; and

wherein said data processor is configured to establish a common reference coordinate system between said each camera in said first and second sets of cameras, utilizing images of said first and second reference targets.

**11.** The improved machine vision vehicle wheel alignment system of Claim 10 wherein said first set of cameras is affixed to said first runway; and wherein said second set of cameras is affixed to said second runway.

**12.** The improved machine vision vehicle wheel alignment system of Claim 10 wherein said first reference target is disposed adjacent said first runway; and wherein said second reference target is disposed adjacent said second runway.

**13.** The improved machine vision vehicle wheel alignment system of Claim 10 wherein each of said first and second sets of cameras includes a front camera and a rear camera.

**14.** The improved machine vision vehicle wheel alignment system of Claim 13 wherein each of said front cameras is disposed adjacent to a front portion of a runway; and

wherein each of said rear cameras is disposed adjacent to a rear portion of a runway.

**15.** The improved machine vision vehicle wheel alignment system of Claim 13 wherein each of said front cameras is configured with a field of view encompassing an optical target disposed on a front vehicle wheel; and

wherein each of said rear cameras is configured with a field of view encompassing an optical target disposed on a rear vehicle wheel.

**16.** The improved machine vision vehicle wheel alignment system of Claim 13 wherein each of said front cameras is configured with a field of view encompassing an optical target disposed on a rear vehicle wheel; and

wherein each of said rear cameras is configured with a field of view encompassing an optical target disposed on a front vehicle wheel.

**17.** An improved machine vision vehicle wheel alignment system including a first set of cameras in a predetermined relationship configured to view at least one or more optical targets disposed on the first side of a vehicle, a second set of cameras in a predetermined relationship configured to view at least one or more optical targets disposed on the opposite side of the vehicle, and a data processor configured to process images and calculate vehicle wheel alignment measurements, the improvement comprising:

a vehicle runway system, said vehicle runway system having first and second runways, said first set of cameras disposed on said first runway, said second set of cameras disposed on said second runway;

at least one common reference target disposed in a field of view of at least one cameras of said first set of cameras and in a field of view of at least one camera of said second set of cameras.

wherein said data processor is configured to establish a common reference coordinate system between said first and second sets of cameras, utilizing images of said at least one common reference target and said predetermined camera relationships.

**18.** The improved machine vision vehicle wheel alignment system of Claim 17 wherein said at least one common reference target includes a first reference target element in a field of view of at least one camera of said first set of cameras, and a second reference target element in a field of view of at least one camera of said second set of cameras;

wherein said first reference target element and said second reference target element are in a predetermined positional relationship; and

wherein said data processor is further configured to utilize said predetermined positional relationship to establish said common reference coordinate system.

**19.** An improved machine vision vehicle wheel alignment system including a first camera system configured to view one or more optical targets disposed on a first side of a vehicle disposed in a service bay, a second camera system configured to view one or more optical targets disposed on a second side of the vehicle, and a data processor configured to process images and calculate vehicle wheel alignment measurements, the improvement comprising:

at least one unique reference target structure associated with the service bay, said at least one unique reference target structure disposed within a field of view of at least one camera from said first and second camera systems ; and

wherein said data processor is configured to utilize identified relationships between said at least one unique reference target structure, said first camera system, and said second camera system to establish said common reference coordinate system.

**20.** The improved machine vision vehicle wheel alignment system of Claim 19 wherein said first camera system and said second camera system are configured for independent movement relative to each other.

**21.** The improved machine vision vehicle wheel alignment system of Claim 19 wherein said data processor is further configured to store one or more calibration values associated with the service bay, said one or more stored calibration values indexed to said at least one unique reference target structure associated with the service bay.

**22.** A method for establishing a common coordinate reference system between at least a first camera system configured to view at least a first set of optical targets and at least a second camera system configured to view at least a second set of optical targets, comprising:

acquiring images of said first set of optical targets with said first camera system;  
acquiring images of said second set of optical targets with said second camera system;

acquiring at least one image of a common reference target with each of said first and second camera systems; and

establishing a common reference coordinate system between said first and second camera systems from said acquired images of said common reference target.

**23.** The method of Claim 22 for establishing a common coordinate reference system further including the steps of:

positioning said first camera system to acquire images of said first set of optical targets;



positioning said second camera system to acquire images of said second set of optical targets; and

wherein positioning of said first camera system is independent of the positioning of said second camera system.

**24.** The method of Claim 22 for establishing a common coordinate reference system further including the steps of:

establishing a first coordinate reference system from said acquired images of said first set of optical targets using said predetermined relationships of said first camera system;

establishing a second coordinate reference system from said acquired images of said second set of optical targets using said predetermined relationships of said second camera system; and

utilizing said first coordinate reference system and said second coordinate reference system to establish said common coordinate system.

**25.** The method of Claim 22 for establishing a common coordinate reference system further including the steps of:

acquiring images of at least one additional set of optical targets with at least one additional camera system;

acquiring at least one image of said common reference target with said at least one additional camera systems; and

establishing a common reference coordinate system between each of said camera systems from said acquired images of said common reference target.

**26.** A method for establishing a common coordinate reference system between a first camera system configured to view a first set of optical targets and a second camera system configured to view a second set of optical targets, the first and second sets of optical targets having a predetermined relationship comprising:

acquiring images of said first set of optical targets with said first camera system;

acquiring images of said second set of optical targets with said second camera system;

establishing a first coordinate reference system from said acquired images of said first set of optical targets ;

establishing a second coordinate reference system from said acquired images of said second set of optical targets; and

establishing a common reference coordinate system from said first coordinate reference system, said second coordinate reference system, and the predetermined relationship between said first and second sets of optical targets. **27.** The method of Claim 26 for establishing a common coordinate reference system further including the steps of:

positioning said first camera system to acquire images of said first set of optical targets;

positioning said second camera system to acquire images of said second set of optical targets; and

wherein positioning of said first camera system is independent of the positioning of said second camera system.